

Transparency on scientific instruments

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Scientific instruments are at the heart of the scientific process, from 17th-century telescopes and microscopes, to modern particle colliders and DNA sequencing machines. Nowadays, most scientific instruments in biomedical research come from commercial suppliers [1,2], and yet, compared to the biopharmaceutical and medical devices industries, little is known about the interactions between scientific instrument makers and academic researchers. Our research suggests that this knowledge gap is a cause for concern.

It is the norm—and usually a requirement—that scientists mention instruments and their suppliers in the materials and methods sections of research articles, since their colleagues rely on this information to replicate or adapt their experiments. However, as the production and distribution of instruments have become increasingly commercialized [3], there are signs that this information is no longer sufficient. For example, research conducted by one of us (C.B.) revealed that some scientific instrument makers preferred not to appear as co-authors on manuscripts—even when their employees contributed significantly to it [1]. It was believed that a manuscript would appear more credible if the company's employees did not appear as co-authors, thus enhancing the marketing value of their instrument.

To complement this study, we conducted two surveys of academic researchers in the USA and EU to gauge how they judge information sources for scientific instruments [preprint: 4]. The responses from almost 1,000 academic researchers revealed a marked distrust in manuscripts co-authored by commercial makers of scientific instruments. The first survey inquired whether academic researchers consider information

on instruments important, while the second survey focused on the perceived reliability of different information sources. Combined, they provide insight into how credible academic researchers find information on scientific instruments in peer-reviewed manuscripts. As Fig 1 shows, academics discount both the importance and the reliability of information on instruments in peer-reviewed manuscripts co-authored by scientific instrument firm employees—even when the firm's instrument is not mentioned in the manuscript. When directly comparing the reliability of information on instruments in manuscripts authored by someone from the mentioned instrument firm or not, the difference was statistically significant and substantial. The same perceptions were evident in all scientific fields surveyed [preprint: 4].

We argue that these perceptions create an, as yet underappreciated, incentive for non-disclosure and complementary tactics by scientific instrument makers. This pattern of incentives mirrors those that have generated controversial practices, such as ghostwriting and hidden sponsorship [5]. The revelations of these practices in the biopharmaceutical industry likely fueled a *Zeitgeist* of inherent distrust in firm co-authorship by academic researchers and scientific instrument firms alike.

From a commercial perspective, it is not surprising that some companies circumvent the perceived reduced credibility by not allowing employees to be listed as co-authors, irrespective of whether they contributed significantly to the published work [1]. It boosts the credibility of the manuscript and, presumably, also the commercial instruments employed to generate the research data. Revelations from the biopharmaceutical and medical devices

industries have demonstrated that such concerns are valid. For example, a range of studies showed how commercial sponsorship of academic research on drugs shaped the likelihood of reporting results [6] and influenced the perception of the research [7].

Critically, non-disclosure not only leaves readers unable to judge potential conflicts of interests, but it also makes replication more difficult. More transparency on if and how companies were involved in the experiments could mitigate these risks, as could more detailed information in materials and methods sections, such as instrument settings and downstream data analysis.

In order to assess how much information authors are asked to provide about instruments, we carried out an informal analysis of the guidelines of the 20 most cited journals, as measured by the Google Scholar h5-index in the categories “Health & Medical Sciences”, “Life Sciences & Earth Sciences”, and “Chemical & Material Sciences”. Almost none of the guidelines require the sort of detailed information about instrument settings and procedures required to allow others to replicate the experiment. Moreover, with one notable exception, none of these journals explicitly address the issue of contributions by instrument makers [preprint: 4]—be they financial or technical. Only the guidelines by the American Medical Association (AMA) require disclosing financial contribution, specifying that if an instrument was provided free of charge (a 100% discount), it should be made explicit [preprint: 4].

To illustrate the disclosure dilemma facing scientists, it may be useful to imagine a situation in which an academic researcher received a 20% discount on an instrument

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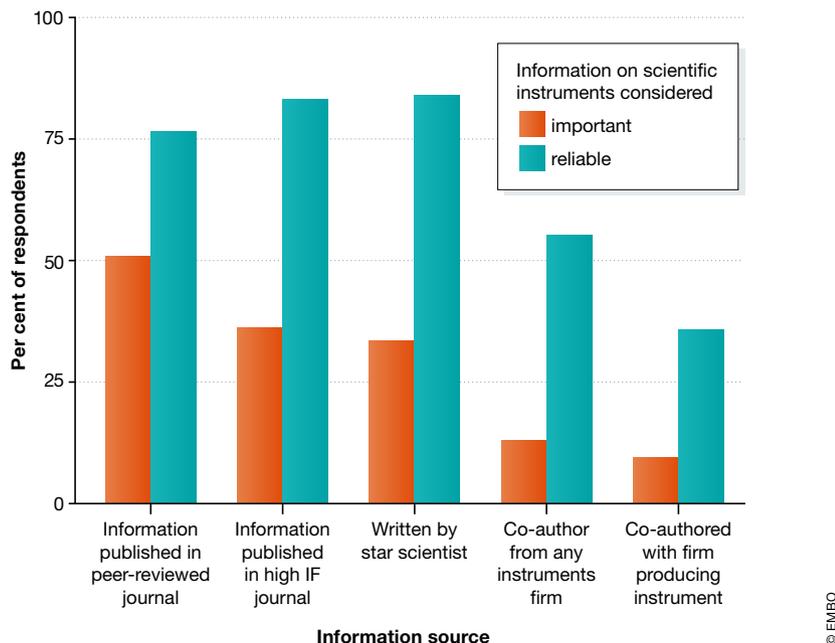


Figure 1. The reliability and importance of information sources on scientific instruments.

Illustration of how important and reliable respondents, indicated in percent on the y-axis, consider information on scientific instruments to be in peer-reviewed publications in general and various subcategories (x-axis).

and considerable assistance from the company with generating and analyzing data from said instrument. The academic publishes the results in a peer-reviewed journal, and the manuscript is cited multiple times. A strict interpretation of journal guidelines would not require the scientist to disclose either the financial benefit or the involvement of the company in data generation and interpretation. Moreover, since being affiliated with a commercial company seems to influence how fellow academic researchers value the manuscript, the academic and the instrument maker have a shared incentive against disclosing pertinent facts.

Public debate and guidelines or policies by academic journals have contributed significantly to tackling non-disclosure issues in pharmaceutical research [3]. More recently, public debate on the reproducibility of the results from biomedical research led to further changes in both norms and journal guidelines [8,9]. We argue that there should be equal attention to commercial instruments that are central to scientific research. As the scientific instrument industry is increasingly dominated by large corporations and as expensive instruments have become commonplace in academic laboratories [10], the debate on reproducibility of and transparency in research should address the

issue of how and when researchers should disclose the involvement of instrument firms in research. Each day that goes by without change further undermines the transparency that is required for reproducibility and scientific progress.

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